

Mole Calculations – Easy

Mark Scheme



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Task 1: calculating the molecular mass (Mr)

Calculate the Mr of the following molecules. Each problem is worth 1 mark.

H_2O $2(1) + 16 = 18$	HNO_3 $1 + 14 + 3(16) = 63$
LiOH $7 + 16 + 1 = 24$	NaCl $23 + 35.5 = 58.5$
NH_4NO_3 $14 + 4(1) + 14 + 3(16) = 80$	H_2SO_4 $2(1) + 32 + 4(16) = 98$
MgO $24 + 16 = 40$	NH_3 $14 + 3(1) = 17$
Ca(OH)_2 $40 + 2(16) + 2(1) = 74$	MgCl_2 $24 + 2(35.5) = 95$
NH_4NO_3 $14 + 4(1) + 14 + 3(16) = 80$	CaSO_4 $40 + 32 + 4(16) = 136$
Al_2O_3 $2(27) + 3(16) = 102$	$(\text{NH}_4)_3\text{PO}_4$ $3(14) + 12(1) + 31 + 4(16) = 149$
Fe(OH)_3 $56 + 3(16) + 3(1) = 107$	K_2SO_4 $2(39) + 32 + 4(16) = 174$
NaHCO_3 $23 + 1 + 12 + 3(16) = 84$	$\text{C}_2\text{H}_5\text{Br}$ $2(12) + 5(1) + 80 = 109$
$\text{C}_6\text{H}_{12}\text{O}_6$ $6(12) + 12(1) + 6(16) = 180$	$\text{C}_2\text{H}_5\text{OH}$ $2(12) + 5(1) + 16 + 1 = 46$
Ti_2CO_3 $2(48) + 12 + 3(16) = 156$	C_5H_{12} $5(12) + 12(1) = 72$
$\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$ $2(23) + 12 + 3(16) + 7(18) = 232$	

Skill 2: calculating the moles of a substance

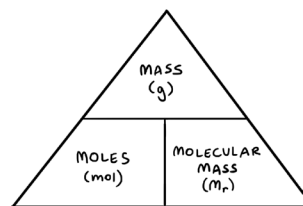
The moles of a substance can be calculated by dividing the mass of the substance by its Mr.

Example 2: calculate the number of moles in 81.90 g of NaCl.

$$\text{Moles} = \text{mass} \div \text{Mr}$$

$$\text{Moles of NaCl} = 81.90 \text{ g} \div 58.5$$

$$\text{Moles of NaCl} = 1.40 \text{ mol}$$



Task 2: calculating the moles of a substance from its mass

Calculate the number of moles of each for the following substances. Give your answers to **3** significant figures.

72 g of H ₂ O Moles of H ₂ O = $\frac{72}{18} = 4.00$ mols	56.40 g of K ₂ O Moles of K ₂ O = $\frac{56.40}{94} = 0.600$ mols
15.9 g of CuO Moles of CuO = $\frac{15.9}{79.5} = 0.200$ mols	9.8 g of H ₂ SO ₄ Moles of H ₂ SO ₄ = $\frac{9.8}{98} = 0.100$ mols
50 g of Fe ₂ (SO ₄) ₃ Moles of Fe ₂ (SO ₄) ₃ = $\frac{50}{400} = 0.125$ mols	8 g of NaOH Moles of NaOH = $\frac{8}{40} = 0.200$ mols
426 g of Al(NO ₃) ₃ Moles of Al(NO ₃) ₃ = $\frac{426}{213} = 2.00$ mols	61.75 g of CuCO ₃ Moles of CuCO ₃ = $\frac{61.75}{123.5} = 0.500$ mols
26.5 g of sodium carbonate Moles of Na ₂ CO ₃ = $\frac{26.5}{106} = 0.250$ mols	16.5 g of iron (III) oxide Moles of Fe ₂ O ₃ = $\frac{16.5}{160} = 0.103$ mols
28 g of ethanol Moles of C ₂ H ₅ OH = $\frac{28}{46} = 0.609$ mols	150 g of sulfur dioxide Moles of SO ₂ = $\frac{150}{64} = 2.34$ mols
17 g of sodium nitrate Moles of NaNO ₃ = $\frac{17}{85} = 0.20$ mols	10.65 g of iron (III) chloride Moles of FeCl ₃ = $\frac{10.65}{162.5} = 0.0655$ mols
1280 g of ammonium sulfate Moles of (NH ₄) ₂ SO ₄ = $\frac{1280}{132} = 9.70$ mols	

Skill 3: calculating the mass of a substance

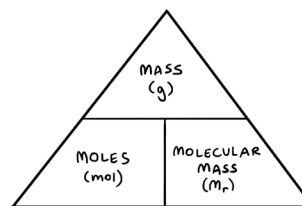
The mass of a substance can be calculated by multiplying the mols of the substance by its Mr.

Example 3: calculate the mass of 0.8 mol of calcium carbonate.

$$\text{Mass} = \text{mols} \times \text{Mr}$$

$$\text{Mass of CaCO}_3 = 0.8 \text{ mol} \times 100$$

$$\text{Mass of CaCO}_3 = 80 \text{ g}$$



Task 3: calculating the mass of a substance from its mols

Calculate the mass of each for the following substances. Give your answers to **3** significant figures.

0.75 mol of $\text{Mg}(\text{HCO}_3)_2$ $\text{Mass of Mg}(\text{HCO}_3)_2 = 0.75 \times 146 = 109.5 \text{ g}$ $= 110 \text{ g}$	1.25 mol of ZnCl_2 $\text{Mass of ZnCl}_2 = 1.25 \times 136 = 170 \text{ g}$
0.45 mol of SiO_2 $\text{Mass of SiO}_2 = 0.45 \times 60 = 27.0 \text{ g}$	0.62 mol of MnSO_4 $\text{Mass of MnSO}_4 = 0.62 \times 151 = 93.60 \text{ g}$
0.2 mol of beryllium nitrate $\text{Mass of Be}(\text{NO}_3)_2 = 0.20 \times 133 = 26.60 \text{ g}$	

Skill 4: calculating the Mr of a substance

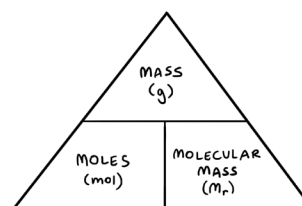
The Mr of a substance can be calculated by dividing the mass of the substance by its mols.

Example 4: A student has 5 mols of aluminium oxide with a mass of 510 g.
What is the Mr of aluminium oxide?

$$\text{Mr} = \text{mass} \div \text{mols}$$

$$\text{Mr of Al}_2\text{O}_3 = 510 \div 5$$

$$\text{Mr of Al}_2\text{O}_3 = 102$$



Task 4: calculating the Mr of a substance from its mols

Calculate the Mr of each for the following substances. Give your answers to **3** significant figures.

3 mols and 132 g of substance $\text{Mr} = 132 \div 3 = 44.0$	2 mols of 92 g of substance $\text{Mr} = 92 \div 2 = 46.0$
3 mols and 175.5 g of substance $\text{Mr} = 175.5 \div 3 = 58.5$	50 mols of 3.975 kg of substance $\text{Mr} = 3975 \div 50 = 79.5$

Skill 5: calculating the number of atoms in a given mass

The number of atoms present in a given mass can be calculated by multiplying its mols by Avogadro's constant, 6.02×10^{23} .

Example 5: using Avogadro's constant, calculate the number of atoms in 336 g of iron.

$$\text{Mols of Fe} = \text{mass} \div \text{Mr}$$

$$\text{Mols of Fe} = 336 \div 56$$

$$\text{Mols of Fe} = 6 \text{ mols}$$

Number of atoms = mols $\times$ Avogadro's constant

$$\text{Number of atoms} = 6 \times 6.02 \times 10^{23}$$

$$\text{Number of atoms} = 3.61 \times 10^{24}$$

Example 6: using Avogadro's constant, calculate the number of atoms in 23.52g of NaHCO_3 .
In this case we must multiply our answer by 6 as each molecule has 6 atoms in it.

$$\text{Mols of NaHCO}_3 = \text{mass} \div \text{Mr}$$

$$\text{Mols of NaHCO}_3 = 23.52 \div 84$$

$$\text{Mols of NaHCO}_3 = 0.28$$

Number of atoms = mols $\times$ Avogadro's constant

$$\text{Number of atoms} = 0.28 \times 6.02 \times 10^{23}$$

$$\text{Number of atoms} = 1.6856 \times 10^{23}$$

$$\text{Number of atoms} = 6 \times 1.6856 \times 10^{23}$$

$$\text{Number of atoms} = 1.01136 \times 10^{24}$$

Task 5: calculating the number of atoms in a given mass

48 g of magnesium $\text{Mols of Mg} = \frac{48}{24} = 2.00 \text{ mols}$ $\text{Number of atoms} = 2.00 \times 6.02 \times 10^{23}$ $\text{Number of atoms} = 1.20 \times 10^{24}$	0.4 mol of oxygen gas. $\text{Number of molecules} = 0.4 \times 6.02 \times 10^{23}$ $\text{Number of molecules} = 2.41 \times 10^{23}$ $\text{Number of atoms} = 2.41 \times 10^{23} \times 2 = 4.82 \times 10^{23}$
1.25 mol of ZnCl_2 $\text{Number of molecules} = 1.25 \times 6.02 \times 10^{23}$ $\text{Number of atoms} = 3 \times 7.525 \times 10^{23}$ $\text{Number of atoms} = 2.26 \times 10^{24}$	0.80 mol of Na_2O $\text{Number of molecules} = 0.80 \times 6.02 \times 10^{23}$ $\text{Number of atoms} = 3 \times 4.816 \times 10^{23}$ $\text{Number of atoms} = 1.44 \times 10^{24}$
The formula of calcium acetate is $\text{Ca}(\text{C}_2\text{H}_3\text{O}_2)_2$ Calculate the number of atoms that combine together to form 39.50 g of calcium acetate. $\text{Mols of Ca}(\text{C}_2\text{H}_3\text{O}_2)_2 = \frac{39.50}{158} = 0.25 \text{ mols}$ $\text{Number of molecules} = 0.25 \times 6.02 \times 10^{23} = 1.505 \times 10^{23} \quad \text{Then we multiply by 15}$ $\text{Number of atoms} = 2.26 \times 10^{24}$	